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11th December 2009

POSITION STATEMENT ON CLIMATE CHANGE AND RELATED ISSUES DST / NRF CENTER OF EXCELLENCE

Prepared for the Joint Meeting of the Portfolio Committee on Water and Environmental Affairs, PC on Science and Technology, PC on Rural Development and Land Reform, PC on Agriculture, Forestry and Fisheries, PC on Energy, and SC on Land and Environmental Affairs, PC on Tourism: [Public Hearings on Climate Change and sustainable Development]

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In a nutshell
South Africa plays an important role internationally in understanding global warming and planning a response to the daunting scientific and social challenges that it presents. South Africa can enhance its stature and benefit its people by taking advantage of the opportunities that our location and history provides us to be a leader in this field. The benefits will accrue, for instance, in education at all levels, and in quest to alleviate poverty. The remarkable geographic, biological, social, and economic diversity of southern Africa makes the region a potential focus of efforts to improve earth stewardship. This is where we can develop novel methods for helping the poor cope with future climate variations, by learning from and working with them in their efforts to deal with the droughts, floods and fires they already suffer every season. Studies of the exceptional plants and animals of southern Africa and the surrounding oceans can enhance our understanding of, and ability to predict, a changing world.

1. The science of Global Change

Many things are changing rapidly and simultaneously in the world: the population, economy, power relations and governance systems, trade patterns and technology, to name some. Collectively these are changing the workings of the natural processes that have kept the planet in a liveable state. The consequence is a series of discrete but inter-related issues: climate Change (often referred to in public debate simply as "global warming', but including changes in the amount and reliability of rainfall), sea level rise, ocean acidification, stratospheric ozone depletion, biodiversity loss and more. These problems have been developing for decades, but have recently gained public and political significance and attention, resulting in a raised public consciousness of the problem. The Intergovernmental Panel on Climate Change has achieved unprecedented international scientific consensus that the phenomenon of climate change poses a serious challenge to human well-being on several fronts: socially, economically and environmentally. Climate change is clearly a global

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challenge but its causes and impacts are not evenly distributed over the planet's surface, which has important political implications for negotiating effective responses. Climate change is now attributed with a high level confidence to the accelerating emission of several greenhouse gases as a result of human activities in modern times. Carbon dioxide is the main greenhouse gas, and at present it mostly comes from the use of fossil fuels such as coal, oil and gas. Other gases (for example methane and nitrous oxide) also contribute, as well as other processes such as land use changes. The result is increased ocean acidification (OA) and increased warming of the atmosphere (GW) which drives climate change (CC), i.e. changes to the pre-industrial envelope of variability in climate and seasonal patterns. This in turn is causing changes to the structure and functions of terrestrial and marine ecosystems within which our modern human society has developed. These phenomena are interlinked with complex feedbacks and interactions. The current and future potential impact of climate change on the earth system is the subject of intense enquiry and debate, due to several remaining uncertainties. The relationships between causes of the problems, solutions for managing them and actions to cope with them are complex and are characterised by lags between action and effect. The scientific assessment of the problem and its trajectory is not complete. Significant uncertainty persists that can not exclude both higher or lower sensitivity of the climate system to greenhouse gas increases)

Climate change poses profound ethical and policy challenges. It requires balancing the needs of the historically disadvantaged' with the avoidance of creating generations of future disadvantaged'. The economic and social impacts and response options are fraught with potentially conflicting needs for development, poverty alleviation and sustainability. The ability to adapt to, and the imperative to mitigate against climate change differs significantly across society, depending on levels of relative wealth and poverty.

The notion of restorative justice is a consideration. Climate change is attributed mainly to historic emissions of greenhouse gases from industrialized (developed) nations as a direct outcome of the processes that allowed the disproportionate accumulation of wealth in those countries. In the current era, developing countries (including South Africa) are an increasingly large part of the global supply, manufacturing and consumption chain and are therefore not absolved from responsibility.

South Africa is in a challenging position. We have a relatively well developed physical and economic infrastructure yet suffer high levels of poverty. As a consequence we are a relatively small absolute emitter of CO2 on a global scale, but a high per capita emitter (unevenly distributed geographically and socio-economically), and a very high emitter per unit of GDP. We are a major fossil fuel user and exporter, in the form of coal. , We have substantial development requirements, including for energy, but currently a shortage of electrical power. We are regarded internationally as having a key leadership role in Africa and among the relatively high-income developing countries and have been active in the global debate (via the UN Framework Convention on Climate Change and other fora).

The increased awareness of climate change represents an opportunity. Given that climate change is such a sectorally cross-cutting, trans-disciplinary issue, all facets of society are beginning to engage with it. This affords us a unique opportunity to achieve true integration of planning and development, which has been elusive to date. Climate change is a business opportunity for the development of innovative technology and services related a "green" economy (and a means of providing manufacturing opportunities and other livelihoods). Probably most importantly, ilt is an opportunity for education - the environmental crises provide the opportunity to engage youth in their own world and provide a platform for broad education about earth systems and how people interact with it. This harbours the prospect of a new generation of graduates, with the skills, knowledge and values to tackle the difficult problems of the coming century.

South Africa has a unique biophysical social environment that provides an ideal setting for a research and training programme of global significance. The ACCESS programme, a DST /NRF Centre of Excellence, rooted in the DST Global Change Grand Challenge Programme and hosted by the CSIR in partnership with several HEIs and government agencies, sets out to make use of this comparative advantage. ACCESS seeks to provide an African perspective on Earth System dynamics (including climate) and provide a sound scientific basis for considering issues of Environmental Justice.

2. Understanding environmental threats

Environmental change occurs on a range of scales, some of which we take for granted. Our society functions within what we have come to regard as a the "normal' envelope of tolerated variability. (e.g. day to night, summer to winter, summer to summer). Occasionally the boundaries of natural variability are exceeded to a degree to which we are either not accustomed to (say a 1 in 100 year storm) of which there is no living memory. These are characterised as "extreme events". Occasionally events occur that are of a magnitude that cannot be managed (e.g. volcanoes, earthquakes, tsunamis) and are regarded as "natural disasters".

Natural occurrences of extreme events with catastrophic impacts are common in the history of the planet (e.g. ice ages and sea level changes). However the recorded history of our species- a few thousand years - is a very short period of the planet's geological past.

With global warming trapping more energy in our atmosphere, it is predicted with high confidence that extreme events will be both more intense and more frequent in future (thereby exceeding the envelope of variability that we have become used to, and in which modern civilisations evolved.) The precise impacts are still the subject of much research and debate, but there are likely to be material effects on many economic activities such as food production (agriculture), fisheries and waste assimilation, as well as direct consequences for the health and safety of people.

Continuing environmental change of one form or another is inevitable. Significant evidence already exists of measurable (negative and positive) impacts of recent anthropogenic warming on the biosphere, notwithstanding the fact that we have the means of engaging these changes, in more sustainable and equitable ways.

3. Existing Mal-adaptation and adapting to climate change

CC is one of several human mediated environmental risks. Some others include over-fishing, Acid Mine Drainage, poor land and waste management and alien invasive species. There are many other examples of how humans have disrupted natural ecosystems on which they depend for continued supply of ecosystem goods and services. CC is an integrator and higher level accumulation of several of these human mediated environmental risks and threats as it adds a quantum to these threats depending on their climate related linkages.

The global (and local) distribution of wealth is skewed and Africa carries the burden of most of the world's poverty. The link between economics and environmental risk is associated with the fact that our society is poorly adapted to existing ranges of natural climate variability, predominantly (but not exclusively) in the case of the poor who cannot afford to protect or insure themselves adequately against current seasonal variability and particularly the extreme events. While coastal infrastructure is damaged by winter storms, and droughts and floods impact negatively of the production of crops, people die (in the Western Cape for example) from ordinary seasonal change mediated risks, due to lack of sanitation and means to ameliorate the impact of extreme (but natural) seasonal climate related events. Examples of this are winter storms, wind-fuelled shack fires, infant mortality due to pneumonia and diarrhoea, cholera and malaria - which are diseases with a strong seasonal prevalence. This is exacerbated by the impacts of malnutrition and HIV. These problems are located mainly in poor communities which suffer much higher rates of infant mortality (as an index of vulnerability) than wealthy communities. In order to deal with these current and urgent problems, development and economic growth is required on a massive scale. This in turn requires increased energy supply and infrastructure development - including improved services such as education, health care, waste and sanitation, adequate housing with water and electricity and protection of the environment.

Infrastructure is also vulnerable to climate mediated risk. Pressure to expand the built environment and associated infrastructure results in "building in harm's way" (in vulnerable coastal areas and flood planes for example), which occurs due to the lack of inter-generational memory of lower frequency extreme events (such as 1/50, 1/100 year storms). Poor environmental management and building practices increases vulnerability to natural (pre-CC) extreme events such as flooding, erosion, coastal erosion, storm water runoff scouring, fires, spread of disease and other societal ills.

Thus, stronger environmental signals (predicted as a consequence of GW and CC and other factors) are likely to exacerbate these existing challenges and problems.

All of these challenges are exacerbated by the fact that in general, we have weak institutional structures (which is both a legacy of the past and of the present) and inadequate policy and enforcement for ameliorating the drivers of environmentally mediated vulnerability. Thus increasing urbanization, poor urban and rural land management have reduced the resilience of our environment and society to cope with existing and future climate and environmental changes. This has more to do with increased vulnerability and risk by virtue if mal-adaption rather than changing threat levels.

4. Confronting uncertainty

Despite the fact that there is a justifiable scientific basis for action to reduce the risk of climate change, there remain significant gaps in our knowledge of the structure and function of our earth systems and biosphere (including the physical and biological environment). Uncertainties persist in the science of climate dynamics and the dynamic linkages, feedbacks and coupling of between the different elements (land, ocean and atmosphere), particularly due to a poor level of information gathering and scientific enquiry in the southern Hemisphere and in Africa. These uncertainties have implications for our understanding of the trajectory of climate change risk on a local, regional and global scale and the potential effect of our efforts to mitigate change and/or to adapt to it.

One example of this is that the natural flux of carbon dioxide between the southern ocean and the atmosphere is so great that even small proportional changes to that (background or natural) flux will offset the ameliorating impact that any global agreement on reducing human derived carbon emissions could have. Yet we have very little understanding of the mediating processes of that natural flux (which may well be weakening perhaps as consequences of OA and the increasing CO2 concentration of the atmosphere) in an area of global significance that is on our doorstep. Further more, we do not adequately understand the processes that mediated the historical changes to the earth's climate in the planets geological past. This remains the only conceivable test of long range forecasts of future climates (by forecasting backwards = hindcasting) and is thus critically important in understanding the rate and scale of future climate changes.

These examples also remind us that we live in a connected and coupled earth system and that regional and global ocean-atmosphere processes from within and beyond our region, drive climate dynamics and weather in southern Africa (as they do elsewhere). Thus we need to understand that our Southern African domain extends well beyond the African landmass, into the surrounding oceans of regional and global influence.

The social aspects of how to integrate environmental risk into development practice in a sustainable yet equitable manner is also not well understood. In addition, the means of reducing the dependence of economic growth and development on the continuous (but ultimately limited) supply of natural resources (and subsequent waste production) remain elusive. The institutional, legal and economic tools required to achieve this will require quite fundamental shifts in traditional thinking and yet remain an ear-splitting imperative as demonstrated by service-delivery protests and increasing conflict over limited resources in under-developed economies. Clearly, there is an urgent need to reduce the uncertainties inherent in all of these considerations.

5. The Ethical Dilemma

Significant sections of human society are consuming vastly more resources than could be sustained if all people enjoyed similar lifestyles. Traditional wealth creation through development, which depends on the exploitation of renewable and non-renewable natural resources (and which has afforded the typically benevolent social welfare systems and wealth of the industrialized world, which in turn produces the bulk of the carbon dioxide and other GHG emissions), remains accessible to only a minority of southern African citizens. Unless carefully managed and not adequately exploited, Climate Change mitigation actions could ultimately limit development and rob the poor of an opportunity to overcome poverty in the short term, even while addressing climate change risk in the long term.

Given that we have a "pre-development" energy shortage, should South Africa reduce

its coal consumption and export in order to reduce its carbon emissions (we are ~2% of the global problem but ranks as the 14th worst per capita emitter)? Should we depend more on alternative energy? What are equitable economic means of making this a viable option? Should the city of Cape Town promote energy efficiency (reduced C02 emissions footprint) so that its citizens consume less electricity even if that results in lower revenue (which is urgently required to address transport shortfalls)?

In order to solve these dilemmas, we need to find a way to provide meaningful and urgent development in a way that decouples economic development dependence on what is erroneously assumed to be a limitless supply of natural resources which results in over-exploitation and damage to the environment. This solution lies in the realm of social, economic and political science, augmented by novel technological solutions. The role of science is not only to assess change and the impact of change, but to produce the technical skills to address these dilemmas.

In order to ensure equity, we need to address future environmental risk along with the current environmental risk endured by our society's poor. We are thus lead to ask the question: How are the impacts of climate change distinguished from the impacts of poverty and under-development? Furthermore, if the African ministers were to succeed in the Copenhagen Summit demand for compensation from the industrialised nations for the predicted impacts of climate change on Africa, what would they spend it on? What are our most urgent needs and how will these be determined? What is the best way to adapt to climate change in poverty dominated economy?

Another area of concern is the message that climate change is communicating to our youth. It is essential that we communicate a message of hope, prosperity and positivity as opposed to the threat of impending doom, lest we discourage the youth from engaging positively in their world. We need to engender joy and love for life and the planet as opposed to fear of the future. This psychological perspective must be accounted for so that the challenges we face can be used as leverage to engage all youth in our collective future.

6. The opportunity

While South African society is very energy inefficient, we are blessed with quite unique alternative energy resources (radiative sunlight in particular). South Africa has an almost unique biospehere and one which is recognized internationally for its scientific potential. Carbon trading and sequestration offsets are emerging as new global "currency" for which we are well placed to exploit economically.

South Africa has a selectively-developed educational system, characterized by pockets of excellence that are unevenly distributed. There is a largely untapped resource of under-educated people and thus, with the appropriate investment, we have the potential to produce a new and transformed generation of expertise.

Africa does not yet have an adequately independent voice on global issues related to climate change. Our efforts are well integrated in international programmes which is both an advantage and a disadvantage. While international engagement provides a significant input into our develop, both the science and the associated policy development requires independence and sensitivity to our particular systems and circumstances. The need for an independent African perspective is supported by the recent continental AU developments around these issues.

Thus, the global emphasis on climate change provides the opportunity to address all of these issues by:

a) Creating a unique African institution for the study of the earth system climate dynamics and the human dimension in the sub-region which is directed at the uncertainties and weaknesses in mainstream thinking and thereby adds value and innovation (globally) in an efficient manner.

b) Providing an educational opportunity to bring the youth into science and technology and to teach them about their world in a unique setting, thereby skilling students in a set of multi-disciplinary and socially conscious approaches to problem solving.

c) Expeditiously developing the financial services framework for maximizing the benefits of carbon trading.

d) Promoting innovation in new technology and policy for mitigating climate change

with alternative energy and other hard and soft innovations and entrepreneurial opportunities.

e) For developing new approaches to development that addresses competing imperatives of sustainable development and genuine poverty alleviation actions.

The ACCESS programme is a key element of the DST's Global Change Grand Challenge which sets out to address these challenges and opportunities. ACCESS comprises three main elements:

Education: a programme of development through science which aims to stimulate interest in education generally, advanced numerical and analytical skills used in and outside science and to broaden educational outcomes with integrated and multi-disciplinary problem solving skills.

Research: to make a significant impact on the global state of knowledge on earth systems science, to grow understanding and critical analysis and stimulate interesting and numerate education opportunities and to improve the delivery of robust products to society.

Benefits to Society: robust forecasting, technological and advanced engineering skills.

Glossary of Terms:
• Mitigation (of climate change impacts) (IPCC definition)

Technological change and substitution that reduce resource inputs and emissions per unit of output. Although several social, economic and technological policies would produce an emission reduction, with respect to climate change, mitigation means implementing policies to reduce GHG emissions and enhance sinks.

• Adaptation (to climate Change) (IPCC definition)
Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory, autonomous and planned adaptation:

Anticipatory adaptation - Adaptation that takes place before impacts of climate change are observed. Also referred to as proactive adaptation.

Autonomous adaptation - Adaptation that does not constitute a conscious response to climatic stimuli but is triggered by ecological changes in natural systems and by market or welfare changes in human systems. Also referred to as spontaneous adaptation.

Planned adaptation - Adaptation that is the result of a deliberate policy decision, based on an awareness that conditions have changed or are about to change and that action is required to return to, maintain, or achieve a desired state.